全国高等学校食品质量与安全专业适用教材

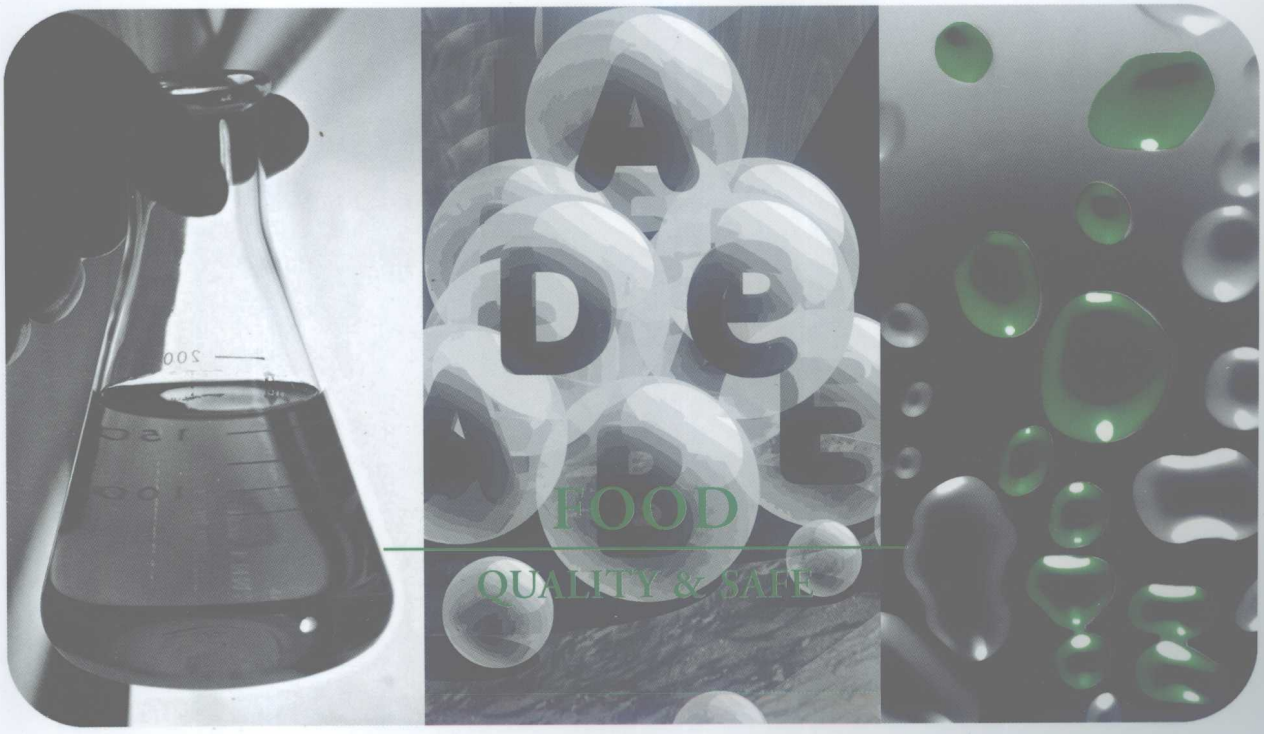
QUANGUO GAODENG XUEXIAO SHIPIN ZHILIANG YU ANQUAN ZHUANYE SHIYONG JIAOCAI

食品质量与安全专业英语

主编　刁恩杰

副主编　李彦杰　徐保成　陈洪兴

SPECIAL ENGLISH FOR FOOD QUALITY & SAFETY



中国轻工业出版社

全国高等学校食品质量与安全专业适用教材

食品质量与安全专业英语

主　编　刁恩杰

副主编　李彦杰　徐保成　陈洪兴

参　编　史碧波　罗晓妙　袁先铃

蒲海燕　张立平　闫讯友

李建民

中国轻工业出版社

图书在版编目(CIP)数据

食品质量与安全专业英语/刁恩杰主编. —北京:中国轻工业出版社,2007.9
全国高等学校食品质量与安全专业适用教材
ISBN 978-7-5019-6036-1

Ⅰ.食… Ⅱ.刁… Ⅲ.食品-质量管理-英语-高等学校-教材
Ⅳ.H31

中国版本图书馆 CIP 数据核字(2007)第 094442 号

责任编辑:姚怀芝 责任终审:劳国强 封面设计:王佳芃
版式设计:马金路 责任校对:郎静瀛 责任监印:胡 兵 张 可

出版发行:中国轻工业出版社(北京东长安街 6 号,邮编:100740)
印 刷:利森达印务有限公司
经 销:各地新华书店
版 次:2007 年 9 月第 1 版第 1 次印刷
开 本:787×1092 1/16 印张:17.5
字 数:352 千字
书 号:ISBN 978-7-5019-6036-1/TS·3522
定 价:35.00 元
读者服务部邮购热线电话:010-65241695 85111729 传真:85111730
发行电话:010-85119845 65128898 传真:85113293
网 址:http://www.chlip.com.cn
Email:club@chlip.com.cn
如发现图书残缺请直接与我社读者服务部联系调换
61147J4X101ZBW

Preface

Access to a secure supply of safe food is a human right. Everyone who is involved in food production, processing, sale and service has a role in ensuring that the food that reaches our tables will not be a hazard to human health. At the start of the 20th century, several food safety issues were brought to the public's attention, such as mad cow disease, Aphthae Epizootic, Dioxin, Avian Influenza (H5N1), and so on. We are now in the 21st century and, food safety issues have as high a priority and significance as they did over 100 years ago. Public concerns have arisen regarding high-profile food-borne illness outbreaks due to contamination of food with certain pathogens (e. g., *Salmonella*, *Escherichia coli* O157:H7, *Listeria monocytogenes*, and others) which have serious acute impact and potential chronic long-term complications in the ever-increasing high-risk population segment (e. g., elderly, children, immuno-compromised). Food safety issues not only prevented food-borne illness, but also which expanded food safety research, risk assessment, training and education programs, and enhanced food establishment inspection systems. Pathogen issues have also resulted in endorsement and implementation of comprehensive prevention and intervention strategies, such as the Hazard Analysis and Critical Control Point (HACCP) system, by the regulatory and industrial communities.

As the world has gotten smaller through increased communication, travel, immigration and trade, there are current concerns regarding the safety and quality of food products throughout the world. Global consumer concerns regarding genetically modified foods and ingredients, as well as potential chemical residues in foods, have had a major impact on current and future legislation, as well as world trade.

The intent of this book is to define and categorize the real and perceived safety and quality issues surrounding food, to provide scientifically non-biased Dr of Dong Haizhou and Ding Xiaowen, for their enthusiasm and diligence in serving as chief umpire. This book would never have been finished without their help.

Diao Enjie

2007. 1

Contents

Part I Characterization of Food Safety

1. Definition of food safety

The term "safe food" represents different ideals to different audiences. Consumers, special interest groups, regulators, industry, and academia will have their unique descriptions based on their perspectives. Much of the information the general public receives about food safety comes through the media. For this reason, media perspectives on the safety of the food supply can influence those of the general public.

Consumers are the end users and thus are at the last link of the food supply chain from production, through processing and distribution, to retail and food service businesses. Consumers are multidimensional and multifaceted. Populations differ in age, life experiences, health, knowledge, culture, sex, political views, nutritional needs, purchasing power, media inputs, family status, occupation, and education. The effect of the interrelationships of these factors on an individual's description of "safe food" has not been established.

When educated consumers were asked by the author to define safe food, their descriptions included some key elements. Safe food means food that has been handled properly, including thorough washing of food that will be cooked and anything to be eaten raw. Safe food means food prepared on clean and sanitized surfaces with utensils and dishes that also are cleaned and sanitized. These consumers mention the importance of hand washing by those involved in food preparation and the importance of not reusing cloths or sponges that become soiled. Common sense is a guiding principle for the educated, informed consumers.

Other consumers want safe food that retains vitamins and minerals but does not have harmful pesticides. They describe safe food as food that is within its shelf life and has been stored and distributed under proper temperature control. Some consumers know the word "contamination" and will define safe food as food that is not contaminated.

For other consumers, the descriptions of safe food are more practical, like food that does not make a person ill. For these consumers, safe food means purchasing fresh foods or raw materials and choosing packaged integrity foods. Consumers use their senses in their descriptions of safe food, and they feel that food that looks or smells bad should not be eaten. Surprisingly, not many consumers refer to labeling as a key component of safe food. Consumers believe they know what to do with food after it is purchased, and they assume

that the safety of the food is primarily determined before it reaches their hands.

A national telephone survey indicated that there was a significant variance between what people said they would do and what they actually practiced with respect to food safety in the home. The most common unhygienic practices included infrequent and inadequate hand washing, inadequate cleaning of food contact surfaces, presence of pets in the kitchen, and cross-contamination between dirty and clean surfaces and food. There was a disparity between the level of knowledge and corresponding safe hygiene practices. This suggested that decisions to practice safe food handling likely are based on various factors including knowledge, risk tolerance, and experience.

Special interest groups represent a focused view on safe food. These groups study the issues that they believe are most relevant to food safety and then express their concerns to consumers, regulatory authorities, industry, and academia. They typically define safe food by more specific limits for hazards than those used in the food supply chain. The special interest groups define safe food through more stringent control limits for microbial pathogens and chemical hazards. They seek a higher level of food safety through requirements for more interventions to control hazards and elimination of chemicals used in food production, over fears of adverse health effects.

Special interest groups often question the approvals by governmental agencies of practices designed to increase the productivity and efficiency associated with agriculture and animal husbandry, for example, the use of antibiotics and hormones. Furthermore, the definition of safe food by selected special interest groups would exclude foods made through enhanced technology, such as genetic engineering. Again, they would view with suspicion, the science that established the safety of these new foods for the regulatory authorities responsible for their approval.

Because academicians are some of the most educated consumers, they generally have the greatest understanding regarding the safety of foods, balancing the science with the practical application of the science in the food supply chain. Academicians can be the most knowledgeable about the science-based research used in defining safe food. However, the specifics of research, and the innumerable questions that are generated through research, lead to inevitably variable viewpoints on the science. The academic questions surrounding safe food are often multidimensional, involving scientific disciplines including biochemistry, microbiology, genetics, medicine, plant and animal physiology, and food science, to name only a few. Because academicians generally are narrowly focused in particular research disciplines, their definitions include details surrounded by boundaries and assumptions.

Regulatory authorities are also consumers and thus carry many of the biases and per-

ceptions held by consumers in general. However, regulatory authorities typically have a higher level of training in food safety. They differ in the scope of their responsibilities and influence, working at local, province, national, or global levels. They also differ in their experiences with food along the food chain, from farming and animal production through manufacturing, distribution, and testing, to retail and food service. These experiences will affect their definitions of safe food.

Regulatory authorities that oversee food production are more aware of the impact of agricultural chemicals, animal hormones, feed contaminants, and antibiotics and would include details of these factors in their description of safe food. In processing environments, regulators would be more apt to describe safe food in terms of the microbiological, chemical, and physical hazards associated with manufacturing. Regulatory authorities overseeing retail and food service would include the human factors such as cross-contamination by food handlers and personal hygiene behaviors. Regulatory authorities also describe safe food according to regulations established by authorities such as the World Health Organization (WHO), the European Commission, and the U. S. FDA. The standards and laws set for international trade become part of the regulatory definitions of safe food. For example, the food safety standards adopted by FAO/WHO Codex Alimentarius Commission (CAC) have become the international reference used to resolve international trade issues. Some regulatory authorities are using quantitative risk assessment to help define food safety, as well as to determine optimal intervention strategies. Scientific risk assessments have reportedly become the foundation for food safety worldwide with the issuance of the Sanitary and Phytosanitary Agreement (SPS) by the World Trade Organization (WTO).

The industry sector is broad in its constituency. Farmers and ranchers are the basis on which most of the foods supply chain exists. At this level, food safety is defined by the practices of the farmers and ranchers, whether in regard to chemical treatment of the soil or use of hormones in animal production. These plant and animal producers define safe food based on the practical application of production principles, balancing economic pressures of production with demands for control of hazards. Safe food at this level means doing what is practical to ensure safety and focusing on optimal use of government approved chemicals to maximize production. Thus far, there has not been a significant focus on controlling microbiological hazards at this level of the food chain; however, there is increasing recognition of the role of farmers and ranchers in defining safe food through their practices.

The food industry defines safe food by its specifications for raw materials and finished products. These specifications define the acceptable limits for chemical hazards such as pesticides and hormones, physical hazards such as bone and metal fragments, and microbi-

ological hazards such as *Listeria monocytogenes* and *Salmonella*. The industry defines safe food in terms of pathogen reduction associated with processing technologies, whether well-established like pasteurization or new like pulsed, high-energy light.

The industrial sector also includes distribution, retail, and restaurant businesses, as well as related industries supporting the growth of plants and animals and the use of by-products for nonfood applications, such as for health care and clothing. Distributors, retailers, and restaurants define safe food by the expectations of their customers and the regulatory authorities.

Safe food is a composite of all of the views and descriptions held by consumers', special interest groups, academicians', regulatory authorities, and industry. Almost any single definition of safe food will be overly simplistic, because safe food is a complex, multifaceted concept. The scientific experts attending the 1998 American Academy of Microbiology Colloquium on Food Safety: "Safe food, if properly handled at all steps of production through consumption, is reliably unlikely (i. e., the probability is low and the variability is small) to cause illness or injury." Everyone wants a safe food supply. The criteria by which food is defined as safe will become more detailed and comprehensive as new steps are taken to improve safety. As capabilities rise, so will the expectations. The difficult decisions are those relating to perceived risks that drive the unnecessary use of public and private resources. If a food is perceived or reported to be unsafe, the story can be amplified in the press and then validated in the public mind by the involvement of politicians and regulators. All these can happen in the absence of scientific data that truly defines the risk.

Consumers have a role to play in ensuring that food is safe. They need to make informed choices about their food and how it is handled and prepared. According to experts' suggestions, consumer education about food safety must take place. Without a widely accepted definition of safe food, the public will have unrealistic misconceptions about the degree of safety that is attainable. Some experts pointed out that food safety standard have economic as well as scientific dimensions and that consumers are not likely to pay the high costs of absolutely safe food. To this end, industry and government have responsibility for improving safety as well as for educating consumers on the practical aspects of safe food. Research is needed to determine what impacts consumers' food safety practices.

Global differences in judgments on safe food are likely to continue, such as the current disagreements over the safety of beef hormone treatments and genetically modified foods between the U. S. and the European Union. These differences exist despite mechanisms such as the dispute resolution system of the WTO. In general, the European view of safe food is fundamentally different from that in the U. S., with culture and history as important as

science in some decision-making processes.

2. World-wide food safety issues

Food-borne illnesses are prevalent in all parts of the world, and the toll in terms of human life and suffering is enormous. Contaminated food contributes to $1.5\ 10^9$ cases of diarrhea in children each year, resulting in more than three million premature deaths, according to the World Health Organization (WHO). Those deaths and illnesses are shared by both developed and developing nations. For example, in the United States, the Centers for Disease Control and Prevention (CDC) estimates that food-borne diseases cause approximately 76 million illnesses annually among the country's 290 million residents, as well as 325,000 hospitalizations, and 5,000 deaths. In South East Asia, approximately one million children under five years of age die each year from diarrhea diseases after consuming contaminated food and water.

Accidental or intentional adulteration of food by toxic substances also can result in serious public health incidents. For example: In our country, in 2002, more than 200 schoolchildren were sickened and 38 died when rat poison was used to intentionally contaminate bakery products. In Spain in 1981 ~ 1982, contaminated rapeseed oil killed more than 2,000 people and caused disabling injuries to another 20,000 ——many permanently.

Human costs

Many countries have not yet established adequate surveillance or reporting mechanisms to identify and track food-borne illness. Therefore, data on food-borne diseases are extremely scarce and improvements are needed to better identify the causes of food-borne diseases. The symptoms of food-borne illnesses range from mild to life-threatening. While nausea and diarrhea are the most common, kidney and liver failure, brain and neural disorders, and even death can also result. For example, *Listeria monocytogenes* infection, which mainly affects the elderly and pregnant women, has a mortality rate of 20 ~ 30 percent. The debilitating long-term complications of food-borne diseases also include reactive arthritis and paralysis.

Although everyone is susceptible, infants and young children, pregnant women, the immuno-compromised, and the elderly are more likely to experience food-borne illness with severe consequences. In developing countries, food-borne diseases are a primary cause of malnutrition, which then affects the growth and disease resistance of infants and children. Malnourished infants and children are more vulnerable to a range of ailments, such as

respiratory infections, which can contribute to further malnutrition and disease. Each year, between 12 million and 13 million children die from the combined effects of malnutrition and infection. Those who survive may suffer from arrested physical and mental development, being deprived of the chance to reach their full potential in society.

Economic costs

Food-borne diseases create an enormous burden on the economy. Consumer costs include medical, legal, and other expenses, as well as absenteeism at work and school. For many consumers who live at a subsistence level, the loss of income due to food-borne illness can perpetuate the cycle of poverty. Chronic diseases caused by contaminated food, like reactive arthritis or temporary paralysis, can be even more damaging than the initial disease and add dramatically to the medical costs and lost wages.

Costs to national governments stem from increased medical expenses, outbreak investigations, food recalls, and loss of consumer confidence in the products. Food-borne diseases lead to increased demands on already overburdened and poorly funded healthcare systems in developing countries.

The best estimates of the economic costs of food-borne diseases come from developed countries:

In the United States, a government estimate of seven food-borne pathogens reported a cost of between U.S. $5.6 10^9 to $9.4 10^9 in lost work and medical expenses. In the European Union, the annual costs incurred by the health care system as a consequence of *Salmonella* infections alone are estimated to be around EUR 3 10^9. In Australia, the cost of an estimated 11,500 daily cases of food poisoning was calculated at AU $2.6 10^9 annually. In the United Kingdom, care and treatment of people with the new variant of Creutzfeldt-Jakob disease (vCJD) are estimated to cost the health services about £ 45,000 per case from diagnosis, and a further £ 220,000 may be paid to each family as part of the government's no-fault compensation scheme.

With the globalization of food trade, countries also suffer economic consequences when unsafe food results in lost exports. For example, the 1991 cholera outbreak in Peru, caused by consumption of water and seafood contaminated by the bacteria *Vibrio cholerae*, resulted in more than $700 million in lost exports of fish and fish products. Because of an outbreak of *Cyclospora* (a protozoan parasite) in Guatemalan raspberries in 1996 and 1997, the number of Guatemalan raspberry growers has shrunk dramatically from 85% in 1996 to 3% in 2002. Finally, the effect on both Canadian and U.S. beef exports from findings of bovine spongiform encephalopathy (BSE) in their cattle population resulted in losses of $5 10^9

for Canada's beef sector and $2.6 10^9$ in lost exports for the US' beef sector in 2004.

Tourism is also of great economic importance for many countries. Being a haven for "traveler's diarrhea", can damage the reputation of the country as a tourist destination and has huge consequences for its economy.

Political consequences

Food safety issues can have huge political implications. In Western Europe, BSE has led to more political and structural change than any other food or agricultural issue. In Germany, the emergence of BSE in early 2001 led to the resignation of both the agriculture and health ministers and the restructuring of the agriculture ministry to become more consumer-oriented. In the United Kingdom, responsibilities for food control were transferred from the Ministry of Agriculture, Fisheries, and Food to a new, separate food authority, the Food Standards Agency. Elsewhere in Europe, similar national agencies have been created to ensure adequate regulation of food safety and restore public confidence, and a European Food Safety Authority has been established.

Current and new challenges to food safety

Food safety challenges differ by region, due to differences in income level, diets, local conditions, and government infrastructures. In developing countries, the food producer and the consumer often have a close connection. There are fewer processed and packaged foods; most fresh food is traded in traditional markets; and street vendors supply much of the food consumed outside the home. Perishable food is often prepared and consumed immediately, and there is minimal storage of prepared foods.

Food safety concerns in these countries typically include: the inappropriate use of agricultural chemicals; the use of untreated or partially treated wastewater; the use of sewage or animal manure on crops; the absence of food inspection, including meat inspection; a lack of infrastructure, such as adequate refrigeration; poor hygiene, including a lack of clean water supplies.

As a country's economy develops, its participation in the global food economy and its capital investment in the agricultural sector increase. That gives consumers access to both common and exotic foods throughout the year.

Here are some trends, as reported by WHO, prevalent in both developed and developing countries, that can increase food safety challenges.

Changes in animal husbandry

Modern intensive animal husbandry practices have been used to maximize production.

This has resulted in the emergence and increased prevalence of several human pathogens, like *Salmonella and Campylobacter*, in flocks or herds of all the most important production animals (poultry, cattle, pigs). Crowding of animals has led to the increased use of antibiotics on so-called "factory farms" which in turn has been linked to the emergence of new strains of antibiotic-resistant bacteria. Feeding practices also have come under increased scrutiny as a result of BSE.

Changes in agronomic process

Agricultural practices have contributed to the increased risks associated with fresh fruit and vegetables, such as the use of manure, chemical fertilizers, untreated sewage, or irrigation water containing pathogens. Outbreaks linked to fruits and vegetables have increased in some regions, especially where improvements in transportation and access to imported fruits and vegetables are giving consumers more fresh produce year round. Examples include a major *E. coli* O157:H7 outbreak in Japan linked to sprouts involving more than 9,000 cases in 1996, and several recent *Cyclospora* outbreaks associated with raspberries in North America and Canada, and lettuce in Germany.

Increase in international trade

International trade allows for the rapid transfer of microorganisms from one country to another. The increased time between processing and consumption of food lead to additional opportunities for contamination and time/temperature abuse, increasing the risk of food-borne illness. Increasing trade also means that new and unfamiliar food-borne hazards can more easily reach consumers who have not developed immunities to those pathogens.

Changes in food or agricultural technology

Advances in processing, preservation, packaging, shipping, and storage technologies bring new forms of foods to the market, and sometimes new hazards. For example, the increased use of refrigeration to prolong shelf-life of ready-to-eat foods has contributed to the emergence of *Listeria monocytogenes*. Consumers in many regions have expressed concern regarding the use of technologies like irradiation and genetically-engineered (GE) plants and animals.

Increase in susceptible populations

Due to advances in medical treatment, people are living longer, and surviving with chronic medical conditions that used to kill them. By the year 2025, more than one 10^9 of

the world's population will be over 60 years of age, two-thirds of whom will live in developing countries. As a result, in some countries, one person in four faces a higher risk of contracting a food-borne disease.

Increase in travel

Persons exposed to a food-borne illness in one country can expose others to the infection in a location thousands of miles from the original source.

Changes in lifestyle and consumer demands

Many trends impact the frequency and nature of food-borne illnesses. Consumers like to have access to seasonal foods all year. In many developed countries, a larger share of the food budget is spent on food prepared outside the home. In developing countries, there is a general rise in urban living and street food is an important component of the daily diet. As a result, outbreaks associated with food prepared outside the home are increasing in many regions.

Bioterrorism

Following rising incidents of terrorist attacks in many countries in recent years, concerns about intentional adulteration of food by terrorists, criminals, or other antisocial groups have risen and led to the need for new preparedness efforts. The WHO states that "the key to preventing food terrorism is to enhance existing food safety programs. Strengthening national food safety programs requires that national policies and resources to support the infrastructure are in place and that food legislation, food monitoring and surveillance, food inspection, food-borne disease surveillance, and education and training are adequate and up-to-date."

3. Food safety hazards and health risk

Hazard characterization with respect to foods began as a means to help prioritize risks and categorize hazards. Over time, hazard characterization has broadened in scope, as the criteria used to evaluate hazards have increased in number and breadth. Today, characterization of hazards is more important than ever in developing food safety control programs. The use of categorization is of lesser importance as susceptibility of the population to the hazards becomes greater. The WHO (1995) described hazard characterization as the qualitative and quantitative evaluation of the nature of the adverse effects associated with biological,

chemical, and physical agents that may be present in foods.

Van Schothorst (1998) suggested that hazard characterization might be better termed. The impact can vary from mild (simple acute diarrhea) to severe (chronic illness or death), depending largely on the susceptibility of the person exposed. To accommodate the many assumptions associated with impact characterizations, a worst-case scenario often is used to estimate the risk presented by a particular pathogen in a specific food. Van Schothorst points out that assumptions and uncertainties of hazard characterization ultimately can lead to an unreliable risk assessment, as well as credibility and liability problems.

The National Advisory Committee on Microbiological Criteria for Foods (NACMCF) (1997) defined a hazard as a "biological, chemical, or physical agent that is reasonably likely to cause illness or injury in the absence of its control". Microbial pathogens are the most common biological hazards, and they can cause infections (growth of the disease-causing microorganism) and intoxications (illness caused by preformed toxin produced by a microorganism). Scott (1999) has detailed the characteristics of numerous common microbial hazards and described the factors that affect the risk of illness from the hazards. Chemical hazards include agricultural compounds such as pesticides, antibiotics, and growth hormones; industrial chemicals such as cleaners and sanitizers; and equipment-related compounds such as oils, gasoline, and lubricants. Other chemical hazards include naturally occurring toxicants such as mycotoxins, environmental contaminants such as lead and mercury, and chemical preservatives and allergens. Physical hazards include glass, wood, plastic, stones, metal, and bones. The introduction of physical hazards has been characterized as inadvertent contamination from growing, harvesting, processing, and handling; intentional sabotage or tampering; and chance contamination during distribution and storage.

The language surrounding the term "hazard characterization" has referred to the food products themselves, as well as to the hazards that might be present in the food. Hazard characterization has been used in the development of Hazard Analysis and Critical Control Point (HACCP) plans and regulatory policies, as well as for risk assessments.

The Pillsbury Company is recognized as the first company to have developed HACCP plans. The Pillsbury approach to HACCP systems also used three hazard characteristics to categorize food products. In this instance, the hazard characteristics were generalized to include all potential microbial, physical, and chemical hazards. The use of the three hazard characteristics to assess risks was standard in the 1970s. In 1989, the NACMCF presented a HACCP document that used six hazard characteristics to rank microbial hazards for risk assessments. Chemical and physical hazards were included subsequently. Hazard characterization at this time was made on the basis of criteria such as:

The consumers' risks associated with factors such as age and health, The risk associated with the ingredients used to make the food product, The production process and its impact on the hazard, The likelihood of recontamination after processing, The potential for abuse during distribution and consumer handling, and The ability of the consumer to detect, remove, or destroy the hazard during the final preparatory steps.

The most recent HACCP documents characterize hazards as part of the hazard analysis. The hazard characterization, or evaluation, is done after the hazards have been identified. The criteria for characterizing the hazard include:

The severity of the hazard, to include the seriousness of the consequences of exposure, or the magnitude and duration of the illness or injury;

The likelihood that the hazard will occur, based on published information and epidemiological data;

The potential for both short-term and long-term effects from exposure, and Available risk assessment data, as well as many of the criteria stated in earlier documents.

4. Hazards associated with foods(Biological, Chemical, Physical)

Hazard

A hazard is a biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect. All three types of hazards are associated with fresh produce comprise include others:

Biological hazards

- bacteria
- parasites
- viruses

Chemical hazards

- naturally occurring hazards
- added chemical hazards
- contaminants

Physical hazards

- foreign bodies like glass, wood, stones, insulation, plastic, etc

Biological hazards

Food-borne microorganisms such as bacteria, viruses and parasites are often referred to as biological hazards. Some fungi are able to produce mycotoxins and need to be considered

as chemical hazards.

Micro-organisms hazards

Because microbial pathogens are part of the environment fruit and vegetables can easily become contaminated when they are grown, harvested, stored and handled. Pathogenic bacteria associated with fruits and vegetables include:

- *Salmonella*
- *Shigella*
- *Escherichia coli* (pathogenic)
- *Campylobacter* species
- *Yersinia enterocolitica*
- *Listeria monocytogenes*
- *Staphylococcus aureus*
- *Clostridium* species
- *Bacillus cereus*
- *Vibrio* species

Many bacterial pathogens have been implicated in food-borne outbreaks associated with the consumption of fresh fruits and vegetables. Table 1 – 1 provides a list of many of these outbreaks and the organisms associated with them.

Table 1 – 1 Outbreaks of foodborne disease associated with fresh fruits and vegetables

Agent	Implicated/suspected food	Reference
Campylobacter	Cucumber	Kirk et al. (1997)
Campylobacter jejuni	Lettuce	CDC(1998)
Clostridium botulinum	Bamboo shoots	CDC(1999)
E. coli O157	Apple juice	CDC(1996)
E. coli O157	Radish sprouts	WHO(1996)
Hepatitis A virus	Strawberries	Niu et al. (1992)
Norwalk virus	Mixed salad	Cited by SCF, 2002
Salmonella Enteritidis	salad	Cited by SCF, 2002
Salmonella Muenchen	Orange juice	CDC(1999)
Salmonella Thompson	Root vegetables	Kano et al. (1996)
Shigella flexneri	Mixed salad	Dunn et al. (1995)
Shigella sonnei	Parsley	CDC(1999)